# REMARKS

The following remarks are responsive to the Office Action mailed January 11, 2005.

Applicants respectfully request reconsideration of the present application

## *Oath and Declaration*

The Office Action states that the oath and declaration is defective because the mailing

address of each inventor is not included. Applicants respectfully submit that a signed oath and

declaration with the mailing address of each inventor was filed on March 5, 2004 in response to a

Notice to File Missing Parts, and was received by the OIPE on March 8, 2004 as confirmed by a

returned postcard with stamped date of receipt. A duplicate copy of the oath and a copy of the

returned, stamped postcard are submitted herewith.

## *Objection to Drawings*

The Office Action objects to the drawings under 37 CFR 1.83(a) as not showing every

feature specified in claims 4 and 24. Applicants respectfully submit that that the features

specified in claim 4 are represented at least by step 130 in Figure 3 and that the features specified

in claim 24 are represented at least by controller 208 in Figure 5. Applicants respectfully request

that the objection to the drawings be withdrawn.

## *Amendments to the Specification*

The specification has been amended in several locations to correct typographical errors.

The specification has also been amended in response to objections raised by the Office Action,

which are discussed below.

*Objections to the Specification*

The Office Action objects to the specification as failing to provide proper antecedent

basis for the subject matter claimed in claims 4 and 24. In response, Paragraph [0037] has been

amended to mirror claim 4 and paragraph [0045] has been amended to mirror claim 24. Applicants

submit that under 35 USC §112 second paragraph, the specification in an application for patent

includes the claim or claims as filed in the application. Therefore, given that claim 4 and claim 24

are original claims appearing at the time the application was filed, applicants submit that no new

material has been added.

The Office Action objects to the specification because of an informality on page 11, line

2 (paragraph [0029]). In response, the informality has been corrected in the manner suggested by

the Examiner.

The Office Action objects to the specification because *"ACCL-127, as exemplified on the*

*last line of page 12, is not named in such a way for one in the general public to easily locate."*

In response, the specification has been amended in several locations, deleting "ACCL-127" and

identifying the now assigned serial number of the patent application that was previously

identified as "ACCL-127."

Applicants submit that the objections to the specification have been overcome.


*Objections to Claims 1, 3, 11, 14, 18, 20-22, 30 and 35*

The Office Action objects to claims 1, 3, 11, 14, 18, 20-22, 30 and 35 because of a

number of informalities. In response, the informalities have been corrected, in the manner

suggested by the Examiner, with the exception of claim 30. The Examiner's suggested change

from "parameters" to "parameter" in line 2 of claim 30 is unnecessary because the antecedent of

"parameters" is found in claim 22, from which claim 30 depends. Applicants submit that the

objections to claims 1, 3, 11, 14, 18, 20-22, 30, and 35 have been overcome.

### *Objections to Claims 22, 23 and 35-37*

The Office Action objects to claims 22, 23 and 35-37 as being dependent upon a rejected base claim (independent claim 21), but otherwise allowable. Applicants traverse the rejection of the base claim below.

### *Summary of Claim Rejections*

Claims 21, 23-25 and 34 have been rejected under 35 USC 103(a) as being unpatentable over US Patent Application Publication 2004/0092815 of Schweikard et al. ("Schweikard") in view of US Patent 5,117,829 of Miller et al. ("Miller"), and further in view of Penny et al., *A Comparison of Similarity Measures for Use in 2-D – 3-D Medical Image Registration*, 17 IEEE Transactions on Medical Imaging, 586 (Aug. 1998) ("Penny").

### *Status of Claims*

At the time the Office Action was mailed, claims 1-37 were pending in the application. In the present response, claims 1, 3, 11, 14, 18, 20-22 and 35 have been amended to correct informalities and/or more properly recite the claim limitations. The amended claims are supported by the specification and no new matter has been added. Claims 38-43 have been added. The new claims are supported by the specification and no new matter has been added. Therefore, claims 1-43 remain pending in the application. Claims 1-20 have been indicated as allowable. Therefore, the following comments are directed toward the rejected claims.

*Rejection of Claims 21, 23-25, and 34 under 35 U.S.C. 103(a)*

Claims 21, 23-25, and 34 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Schweikard in view of Miller and further in view of Penney. Applicants respectfully traverse the rejection of independent claim 21 and note that claims 23-25 and 34 depend from claim 21.

*Claim 21*

Applicants respectfully submit that the cited references do not teach or suggest all of the limitations of claim 21. Independent claim 21 recites, in part:

> a controller including means for generating said at least one reconstructed 2D image of said target, using said 3D scan data, and using said known location, angle, and intensity of said imaging beam; and software for determining a set of in-plane transformation parameters (x, y, $\theta$) and out-of-plane rotational parameters (r, $\phi$), said parameters representing a difference in the position of the target as shown in said radiographic image as compared to the position of the target as shown by said 2D reconstructed image; wherein r and $\phi$ represent rotations of said target about first and second mutually orthogonal axes, said rotations being out-of-plane with respect to said image plane, said out-of-plane rotations representing a projection of said target onto said image plane; and wherein x and y represent an amount of translation of said target within said image plane in the directions of said x- and y- axes, respectively, and $\theta$ represents an amount of rotation of said target within said image plane about an axis perpendicular to both said x- and said y- axes.

The Office Action asserts: *"Penney et al. teaches determination of a set of parameters (x,y, $\theta$,r, and $\phi$) representing a difference in the position of a target shown in a radiographic image as compared to a position of the target as shown by a reconstructed image (page 592, col.1, paragraph 2, through col. 2, paragraph 1)."* Applicants respectfully disagree, and submit that the quoted section of Penney (or elsewhere in Penney) fails to teach or suggest the subject limitation of claim 21.

Page 592, col.1, paragraph 2 through col. 2 paragraph 1, relied on by the Office Action as

a basis for the §103(a) rejection, is reproduced below:

> The search space for the algorithm was the six rigid-body degrees-of-freedom. The parameters associated with perspective projection ($c_s$, $l_s$, $k_1$, and $k_2$) were held fixed at their "gold-standard" values. Some similarity measures (entropy, pattern intensity, and gradient difference) necessarily calculate the intensity scaling between the two images(s). This introduces another parameter into the optimization.
>
> The search strategy uses the current parameters (P) to form a DRR, which is then compared to the fluoroscopy image using a similarity measure to obtain a value ($V_0$). The rigid-body parameters of P are then altered one at a time by $\pm w_P$ $\delta_P$, a new DRR created, and a new value of the similarity measure calculated ($V_1$, $V_2$, . . . , $V_{12}$). The weighting factor $w_P$ equals unity for all the rigid-body parameters except for translations in the X direction. Because movements along X have a much smaller effect on the DRR than movements in the other degrees-of-freedom, $w_X$ was set to four. The values $V_1$, $V_2$, . . . , $V_{12}$ indicate which parameters currently have a local optimal value and which parameters could be changed to improve the value of the similarity measure. A movement was made in these latter parameters which was weighted by the size of the improvement in the similarity measure. This was repeated until all six parameters were at an optimum value ($V_0 < V_i$, $i = 1$ to $12$). At this point, $\delta_P$ was reduced and the process restarted.

As seen from the quotation above, Penney teaches performing searches on, and altering (as a result of these searches) parameters P that are described earlier in Penney as including the rigid body translational and rotational parameters **of the CT volume** with respect to a fluoroscopic image, as well parameters associated with the perspective projection geometry of the fluoroscopy set. (*see* Penney, page 588, last paragraph.) The parameters P, which are described in Penney in the quotation above as *"being used to form a DRR,"* and which are also described as being altered one at a time using weighting factors $w_P$ for the parameters, thus are different from the in-plane transformation parameters ($x, y, \theta$) and the out-of-plane rotation parameters ($r, \phi$), which are parameters measuring transformations and rotations with respect to the image plane, and not with respect to coordinates (e.g. the X, Y, and Z axes, described e.g. in Fig. 3 of Penney) in the CT volume coordinate space.

As described in Penney, the parameters P define the position and orientation of the CT

volume with respect to a fluoroscopy set. (*see, e.g.* Penney page 588, col. 1, 3rd sentence in last paragraph: *"The position and orientation of the CT volume with respect to the fluoroscopy set are defined by ten parameters P = (X, Y, Z, $\theta_x$, $\theta_y$, $\theta_z$, $c_s$, $I_s$, $k_1$ and $k_2$), see Fig. 3."* The parameters P described in Penney have nothing to do with in-plane transformation and out-of-plane rotation parameters (with respect to the image plane) that represent a difference in a position of the target shown in an x-ray image as compared to a position of the target as shown in a 2D reconstructed image.

In contrast, claim 21 requires that a controller include software for determining a set of in-plane transformation parameters (x,y, $\theta$) and out-of-plane rotational parameters (r, $\phi$), that r and $\phi$ represent rotations of the target about first and second mutually orthogonal axes, that the rotations are out-of-plane with respect to the image plane, and that the rotations represent the projection of the target onto the image plane, that x and y represent the amount of translation of the target within the image plane in the directions for the x- and y- axes (according to the preamble of claim 21, the x- and y- axes define the image plane), and $\theta$ represents the amount of rotation of the target within the image plane along an axis perpendicular to both the x- and y- axes. The in-plane transformation parameters (x,y, $\theta$) and the out-of-plane rotation parameters (r, $\phi$) are explicitly recited in the cited limitation of claim 21 above (and in other parts of claim 21) as representing transformations and rotations that are in-plane and out-of-plane, respectively, with respect the image plane of the radiographic image. Nowhere in Penney are any parameters that describe transformations and/or rotations with respect to the radiographic image plane taught or suggested.

It is submitted that Schweikard, Miller and Penney, either alone or in combination, fail to teach or suggest the subject imitation of claim 21. Therefore, applicants submit that claim 21 is

patentable over the cited references.

### *Claims 22, 23, 25, and 26-37*

Given that claims 22, 23, 25, and 26-37 all depend from claim 21, and therefore include all the limitations of claim 21, applicants submit that claims 22, 23, 25, and 26-37 are also patentable over the cited references.

### *New Claims*

Claims 38-49 have been newly added. Applicants submit that the newly added claims are supported by the specification and that no new matter has been added. Support for the newly added claims may be found, for example, in paragraphs [0032] through [0041] and in paragraphs [0044] through [0047].

## CONCLUSION

In view of the arguments and amendments set forth herein, applicants respectfully submit that all objections and rejections have been overcome, and that the present application is in condition for allowance. Applicants respectfully request that a timely Notice of Allowance be issued in this case.

If the Examiner believes a telephone interview would expedite the prosecution of this application, the Examiner is invited to contact Richard Thill at (408) 720-8300 x 238.

If there are any additional charges, please charge our Deposit Account No. 02-2666.

Respectfully submitted,

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